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Existence and Stability of Morphodynamic Equilibria in Double Inlet Systems

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Tidal inlet systems, ubiquitous along sandy coasts, are very valuable areas in terms of ecology (breeding and feeding areas), economy (gas–mining and dredging) and recreation, and important for coastal safety. To properly manage these systems, good insight into their morphodynamic behaviour is essential.
In this presentation, we focus on morphodynamic equilibria of so-called double inlet systems, i.e., systems in which the tidal basin is connected to the open sea by two tidal inlets. In our model, the water motion is described by the cross-sectionally averaged shallow water equations, and forced
by prescribed tidal elevations at both seaward sides. The sediment transport is modeled by an advection–diffusion equation with source and sink terms, while the bed evolution is governed by the
convergences and divergences of sediment transports. The sediment transport consists of various contributions, a diffusive contribution, a transport term related to the variations in topography and an advective contribution (ter Brake and Schuttelaars, 2010).
To directly identify morphodynamic equilibria, we employ continuation methods and bifurcation techniques. By systematically varing the amplitude φ_{M2} at one of the inlets, while keeping all other parameters fixed, a region in the φ_{M2} parameter space is found where the bed level reaches the water surface, resulting in two single inlet systems. Outside this region, morphodynamic equilibria exist. These equilibria are characterized by their minimum water depth and location. There are branches of stable equilibria, while there are also branches of unstable equilibria, coinciding with the stable equilibria at so-called limit points. Varying both the amplitude and phase of the M2 tide at one of the inlets while keeping the other parameters fixed, results in limit points in $A_{M2} - \varphi_{M2}$ space that form an ellipse.
In our presentation, we will systematically discuss the number and stability of morphodynamic equilibria and compare our results to observations in the Marsdiep-Vlie system, a double inlet system in the Nothern Dutch Wadden Sea.
References
ter Brake, M. C. and Schuttelaars, H. M. (2010). Modeling equilibrium bed profiles of short tidal embayment. on
the effect of the vertical distribution of suspended sediment and the influence of the boundary conditions. Ocean

Dynamics, 60:183–204.